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Assessment of cod in Division 4X in 2005

Évaluation de la morue dans la division 4X en 2005

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ABSTRACT

Biomass has not increased for 4X cod since 2000, when the quota was reduced to 6000 t to promote rebuilding, and instead has likely declined. There has also been no indication of a decline in mortality since 2000.

Rebuilding was expected to be supported by the incoming 1998 and 1999 yearclasses but their abundance declined more rapidly than expected and an increase in biomass did not materialize. Landings of 5,000 t - 6,000 t, given recent recruitment levels, are resulting in high mortality and are not achieving rebuilding. Prospects for rebuilding are very dependent on the incoming 2003 yearclass and it will need to be conserved more effectively than was the case for the 1998 cohort. To achieve this, fishery removals should be reduced to the lowest level practicable.

RÉSUMÉ

La biomasse de la morue de 4X n'a pas augmenté depuis 2000, alors que le quota avait été réduit à 6 000 t pour favoriser le recrutement; elle aurait plutôt vraisemblablement diminué. De plus, on ne constate aucune indication d'une baisse de mortalité depuis 2000.

On s'attendait à ce que le rétablissement soit appuyé par les classes d'âge de 1998 et 1999, mais l'abondance de celles-ci a diminué plus rapidement que prévu et la hausse anticipée de la biomasse ne s'est pas concrétisée. Compte tenu des récents niveaux de recrutement, les débarquements de 5 000 t à 6 000 t entraînent un taux de mortalité élevé et ne favorisent pas le rétablissement. Les perspectives de rétablissement reposent en grande partie sur la classe d'âge de 2003 qu'il faudra préserver plus efficacement que la cohorte de 1998. À cette fin, les prélèvements par pêche devraient être réduits au plus bas niveau possible.

INTRODUCTION

In the 1960s, landings of 4X cod (including landings from the Canadian portion of 5Y; Figure 1) increased as domestic and foreign otter trawl fleets joined the fishery, The landings dropped in 1970 as effort declined due to restrictions on haddock fishing (Figure 2, Table 1). Recent landings reflect the restrictive total allowable catch (TAC). The TAC from 2000-2004 was 6,000 t annually and landings dropped to the lowest recorded in 2004 at 5,000 t. As of October 27th, 2005, 3,380 t of the 2005 quota of 5,500 t had been landed.

DESCRIPTION OF THE FISHERY

The distribution of the fishery has shifted in recent years, with the Bay of Fundy (4Xqrs5Y) and Georges and Crowell basins in 4Xp increasing in importance (Table 2, Figure 3). Landings in 4Xmno were the lowest on record in 2004. This redistribution of fishing effort is a general pattern in the groundfish fishery, and reflects shifts in fishing patterns and distribution of abundance for a number of species.

The fishery takes place year-round (Table 3). Landings peaked in summer in most years, but recently have been more evenly divided throughout the year. The change in fishery timing reflects the change in the quota year. The fishery continues into late winter as vessels attempt to catch the remaining quota before the end of March.

4X cod are caught as part of a mixed species fishery. Generally, in the last decade, the cod and haddock quotas have been fully utilized, while some Pollock quota has breen left uncaught (Table 4). In 2001-2003, cod was reported to be the limiting species in the fishery. Fishers had to try and avoid cod while targeting haddock. The proportion of pollock quota landed, however, has increased in the last 5 years, while in 2004, the proportion of cod and haddock quota caught dropped. In 2005, pollock quota appears to be limiting for both gillnet and otter trawl <65', while these fleets may again not catch their quota for cod or haddock.

In 2004 and 2005, fishing continued to be poor in coastal areas and on the Scotian Shelf. The number of active vessels (Table 5a), and the number of days fished (Table 5b) declined, reportedly due to the poor economic return resulting from high costs (bait and fuel), and poor catches and prices for groundfish. As a result, in 2004, fixed gear landed only 70% of their cod and 30% of their haddock quotas (Table 4). Landings to October 27 in 2005 were similar to those for 2004, and it appears unlikely that the quotas for either cod or haddock will be reached, despite cuts in TAC for both stocks.

Discrepancies in species composition between trips carrying an observer and unobserved trips may be indicative of potential discarding or misreporting of

landings. The level of observer coverage in 4X has generally been below 1% (Table 6), too low for any meaningful comparisons. Observer coverage in 2005 is lower than in 2004. Much higher coverage stratified to account for variability in the fishery would be required to make useful comparisons of observed and unobserved trips. Experience with the 5Z groundfish fishery, which is less complex, suggests that 10% observer coverage may not always be sufficient for detecting potential discarding.

Catch-at-Age

Fishery Samples

Catch at age was derived following standard protocols for this stock (Clark et al, 2002). Construction of the catch-at-age for the first half of 2005 is detailed in Table 7.

Landings

The size composition of the catch peaks at a somewhat shorter length on the Shelf than in the Bay of Fundy, reflecting differences in growth between these areas (Figure 4). In both areas the peak was consistent with length at age 4, the 2001 year-class. Otter trawl dominated the landings in both areas in 2005. Gillnets tend to catch larger, older cod, but have little impact on the total catch-at-age.

There have been very few fish over age 6 in the landings in recent years. The 1998 yearclass accounted for a greater proportion of the catch in 2004 at age 6 than other recent cohorts at this age, but was reduced to very low level in the landings by 2005 (Figure 5, Table 8).

The 2001 yearclass was dominant in the fishery in both 2004 and 2005. While three year-old cod generally comprise a large proportion of the commercial catch, the 2002 yearclass is almost absent from the fishery in 2005, suggesting it is very low in abundance. There were no age 2 cod in the catch at age for the first half of 2005. Age 2 cod grow into the fishery over the course of the year, and small cod, which are likely age 2, were present in the catch in late summer.

ABUNDANCE INDICES

Abundance indices for this resource are derived from the DFO Research Vessel (RV) survey, and the joint DFO/industry small dragger survey (ITQ). In 2004, the CCGS Teleost was used to conduct the RV survey, since the Needler was unavailable. The comparability of these data with data collected by the Needler in other years was viewed as uncertain in the 2004 assessment (Clark and Hinze, 2004). Preliminary analyses of comparative survey data collected during the 2005 RV survey indicates that the catches by the two vessels are quite comparable.

Further analyses are required to determine exact conversion factors for these vessels, however, the indices are presented as directly comparable for this assessment.

Catches of cod were distributed throughout the management area in the RV survey, however, there were no large catches at any location (Figure 6). The ITQ survey also caught cod throughout the area covered. The largest catches were all in the Bay of Fundy and no catches east of Browns Bank exceeded 50 kg (Figure 7). For most stations in the Bay of Fundy and Gulf of Maine, catches in the 2005 ITQ survey were below the median (Figure 8). Both the proportion of non-zero sets and the proportion where the catch was above the median have been declining in the Bay of Fundy (Figure 9).

On the Scotian Shelf, the research vessel (RV) survey biomass index shows a declining trend from 1996 to 2003 with a modest increase since, though the last three years are the lowest in the time series (Figure 10). The ITQ survey biomass index on the Scotian Shelf has shown no trend, but the 2005 observation is the lowest in the series.

In the Bay of Fundy, the RV and ITQ survey biomass indices have shown no increase since quotas were dropped in 2000 to promote rebuilding (Figure 10).

RV survey cod catches generally peak around 55 cm in the Bay of Fundy and 52 cm on the Scotian Shelf (Figure 11). In 2005, catches were very low at lengths from 46-60 cm in the Bay of Fundy, but above the median around 40 cm and between 65 and 80 cm. (Figure 11). On the Scotian Shelf, catches were above median in the Shelf region below 34 cm, but low for all commercial sizes.

Fewer large fish than usual were caught in the ITQ survey in 2005, particularly in the Fundy region (Figure 12). The catch at pre-commercial lengths (<43 cm), however, was higher than usual in both areas.

Lengths at age for 4X cod from the RV survey remain stable for both the Fundy and Shelf regions (Figure 13). Similarly, there are no persistent trends in commercial weights at age (Table 9).

The indices at age for the RV and ITQ surveys show abundance of older fish is very low in recent years (Figures 14 and 15; Tables 10 and 11). In 2005, this is more pronounced, with indices low for all ages 5 and older, both on the Scotian Shelf and in the Bay of Fundy. The 2001 yearclass appears to be fairly strong in both areas in 2005, but indices for the 2002 cohort have been consistently low. On the Scotian Shelf, the recruitment index for the 2003 yearclass (age 2) was the highest since 1994, while in the Bay of Fundy it was higher than most in the past decade (Tables 10 and 11).

Condition (Fulton's K) has been very stable in the Bay of Fundy (Figure 16). Cod from the Scotian Shelf have shown greater variability in condition. Condition dropped to a low in 1985, but has been fairly stable at average levels recently (Figure 16).

Total mortality (Z), calculated from the RV survey, displays high inter-annual variability but has been high in recent years in both the Bay of Fundy and Scotian Shelf (Figure 17). The total mortality calculated for the ITQ survey is variable without trend (Figure 18). The relative fishing mortality (catch biomass/ survey biomass index), while generally lower since 1995 than in the previous decade, has not declined since the TAC was dropped to 6,000 t in 2000 (Figure 19). The absence of a decline in total mortality or relative fishing mortality indicates that this TAC reduction has not led to a reduction in mortality.

SOURCES OF UNCERTAINTY

Misreporting and discarding of cod in 4X can distort the calculation of relative fishing mortality. There were numerous reports of cod being discarded or landed unreported in 2000 and 2001 to avoid exceeding the quota. This was thought to have decreased in 2002. There have been few reports from industry of misreporting and discarding since.

The precise boundaries of the stock components in 4X are uncertain. Differences in trends among components cannot currently be resolved, and this can affect calculations from survey data.

ADDITIONAL STAKEHOLDER PERSPECTIVES

There were a number of observations that landings and effort were both down in 2005. During the RAP data input review meeting in Yarmouth, it was noted that in 2005 there were not as many cod in Georges Basin during April - mid-May. Fixed gear fishermen also noted that there were few fish inshore, either around Southwest Nova Scotia, or in the Bay of Fundy. Some expressed concern over the reduction in area where cod can be caught, and the lack of old fish in the population.

A combination of the catch rates, the quota and economics (especially high fuel prices, and the monetary exchange rate) make it not worth fishing for cod, and therefore the quota may not be caught in 2005. The fishing industry generally agreed that the stock biomass is currently low and needs rebuilding.

CONCLUSIONS AND ADVICE

Biomass has not increased since 2000 when the quota was reduced to 6000 t to promote rebuilding, and instead has likely declined. There has also been no indication of a decline in mortality since 2000.

Rebuilding was expected to be supported by the incoming 1998 and 1999 yearclasses but their abundance declined more rapidly than expected and an increase in biomass did not materialize. Landings of 5,000 t - 6,000 t, given recent recruitment levels, are resulting in high mortality and stock rebuilding objectives are not being achieved. Prospects for rebuilding are very dependent on the incoming 2003 yearclass and it will need to be conserved more effectively than was the case for the 1998 cohort. To achieve this, fishery removals should be reduced to the lowest level practicable.

OTHER CONSIDERATIONS

Cod, pollock and haddock are often caught together in groundfish fisheries, although their catchabilities to the fisheries differ and they are not necessarily caught in proportion to their relative abundance. With current fishing practices and cod/other species catch ratios, the achievement of rebuilding objectives for cod and pollock may constrain the harvesting of haddock. Additional efforts to protect the 2003 cod yearclass which, from first indications, is estimated to be larger than has been seen in recent years are warranted. An imbalance in quotas creates potential for discarding and may require improved monitoring. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns.

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Table 1. Canadian landings of cod in 4X (and Canadian portion of 5Y) by gear and tonnage class.

	Otter Trawl					Gill Net		Long Line			Hand		
Year	0&1	2	3	4	5+	0&1	2&3	0&1	2	3+	Line	Misc.	Total
1953	27	87	53	3								12,884	13,054
1954	34	113	17	7						321		13,914	14,406
1955	51	121	6	10						271		12,973	13,432
1956	118	104	42	4					376	414		13,791	14,849
1957	240	173	143						1,777	370		10,916	13,619
1958	240	314	127	52				1	1,197	591		8,581	11,103
1959	552	565	274						1,182	608		9,725	12,866
1960	578	426	229	10		1		2,740	1,007	497	4,802	1,833	12,123
1961	505	735	390	12		520		2,269	1,502	597	4,661	1,232	12,423
1962	565	1,007	971	410		645		2,883	1,337	456	4,571	1,811	14,656
1963	258	877	1,159	1,414		748		2,839	1,021	398	5,417	1,660	15,791
1964	457	1,384	1,510	4,063		750		2,672	1,151	677	5,403	2,700	20,767
1965	466	1,758	2,320	7,857		765		3,502	885	564		6,104	24,221
1966	284	2,023	3,064	7,222	72	851		3,733	513	702		5,700	24,164
1967	269	2,359	3,376	7,281	1,483	1,847		3,027	373	940	5,205	1,653	27,813
1968	253	2,245	3,684	7,596	3,111	1,856	0	3,482	479	806	5,766	1,562	30,840
1969	207	1,385	2,448	4,298	3,721	926	0	3,554	513	681	4,446	1,933	24,112
1970	158	1,151	1,529	1,960	1,259	653	0	4,171	515	768	3,444	2,410	18,018
1971	81	1,097	1,611	1,799	1,220	546	4	5,472	691	1,575	4,421	1,783	20,300
1972	121	1,235	1,635	2,246	1,371	1,187	0	6,119	668	1,174	3,128	1,646	20,530
1973	100	1,214	1,232	1,350	553	669	0	7,407	1,048	1,641	3,672	1,105	19,991
1974	128	1,433	1,310	575	577	1,851	0	6,834	1,400	1,096	3,247	490	18,941
1975	129	2,666	1,298	460	601	1,482	27	6,013	1,600	781	2,526	2,001	19,584
1976	82	1,023	1,263	436	896	2,403	167	4,828	1,067	760	2,690	525	16,142
1977	298	1,972	2,909	527	1,065	2,052	79	6,151	1,831	907	2,943	1,254	21,988
1978	615	1,805	2,573	745	1,731	2,562	96	6,904	2,216	1,149	2,059	1,264	23,719
1979	663	1,749	2,744	1,139	1,405	3,527	116	7,517	2,051	862	4,140	2,770	28,683
1980	1,322	2,769	4,284	1,042	2,037	2,683	61	8,356	2,360	898	4,198	1,267	31,277
1981	1,165	3,086	2,989	416	1,131	2,871	114	10,302	2,555	1,235	5,174	483	31,521
1982	879	3,159	4,493	563	2,217	3,154	214	9,120	3,465	1,087	4,299	484	33,134
1983	638	4,735	6,306	518	1,118	2,180	235	5,747	2,757	883	3,750	604	29,471
1984	964	4,198	5,904	302	1,513	1,248	220	3,916	2,825	980	3,005	453	25,528
1985	523	3,954	5,562	90	1,185	1,837	161	2,617	1,740	635	2,755	440	21,499
1986	573	3,663	5,123	224	974	1,453	196	2,479	1,918	576	2,490	371	20,040
1987	312	2,645	3,504	531	929	1,968	241	3,075	2,175	499	2,670	456	19,005
1988	454	3,966	3,542	160	467	903	444	3,528	3,149	672	3,081	171	20,537
1989	409	3,933	4,184	67	713	1,254	475	2,915	2,167	623	2,937	208	19,885
1990	505	3,668	3,577	268	170	1,933	692	4,201	2,967	849	4,871	203	23,904
1991	355	4,598	5,805	298	751	2,225	619	4,712	3,679	842	3,737	128	27,749
1992	238	4,494	5,711	143	726	1,811	586	4,455	3,574	719	3,517	106	26,080
1993	176	2,778	3,598	68	241	1,387	523	2,768	1,693	310	2,439	45	16,026
1994	132	2,022	2,343	138	82	993	421	2,837	1,412	231	2,367	67	13,045
1995	100	1,387	1,619	112	75	470	507	1,632	959	182	1,706	18	8,767
1996	92	1,552	2,314	157	103	611	442	1,774	1,306	201	1,914	106	10,572
1997	79	2,094	2,430	136	35	694	471	2,013	1,255	231	1,794	6	11,238
1998	96	1,407	1,892	166	22	429	376	1,663	997	244	879	0	8,169
1999	85	776	1,254	63	11	494	404	1,480	762	119	743	0	6,190
2000	113	851	1,268	78	9	358	356	1,420	533	106	662	1	5,755
2001	120	975	1,292	29	9	383	390	1,532	423	72	409	0	5,707
2002	181	874	1,482	0	51	520	535	1,487	395	55	286	2	5,869
2003	299	710	1,518	8	5	599	433	1,496	348	60	145	1	5,620
2004	269	667	1,517			582	592	1,036	187	20	122	0	4,993
2005	152	463	771	21		386	339	580	147	11	35	0	2,905

2005 landings for Jan. 1 – Sept. 21.

Table 2. Nominal catch of 4X cod by unit area.

Year	4X[m]	4Xn	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Y	Shelf	Fundy	Foreign
1956	1,981	1,043	5,909		756	2,648	817	1,695		10,204	4,645	1,663
1957	1,929	1,447	6,369		934	2,041	616	283		9,957	3,662	1,083
1958	1,480	1,130	5,056		651	1,859	774	153		7,781	3,322	1,110
1959	2,212	937	5,307		1,123	2,339	957			8,451	4,419	862
1960	1,654	963	5,164		885	2,373	828	256		7,973	4,150	1,605
1961	1,630	1,279	5,275	24	892	2,449	905			8,208	4,246	1,272
1962	1,520	1,031	6,250	651	768	2,946	1,327	163		9,574	5,082	1,280
1963	1,862	829	6,861	1,443	767	2,419	1,579			10,995	4,765	1,995
1964	2,099	2,178	7,174	3,334	1,093	3,572	1,317			14,785	5,982	4,688
1965	1,665	2,088	6,526	7,733	962	4,091	1,215			18,012	6,268	2,693
1966	2,201	1,521	5,444	7,254	1,099	4,607	2,032			16,420	7,738	6,746
1967	2,384	1,400	7,120	8,041	1,276	5,425	2,051			18,945	8,752	4,651
1968	3,251	2,059	8,159	9,341	1,327	4,785	1,849	4	65	22,813	8,027	4,776
1969	2,413	2,923	7,355	5,523	947	3,686	1,120	59	60	18,258	5,828	8,704
1970	2,851	1,300	6,966	2,310	1,077	2,621	847	23	26	13,444	4,577	4,308
1971	2,750	1,728	9,029	2,157	1,395	2,355	754	13	119	15,674	4,626	3,197
1972	3,124	1,585	8,908	1,421	1,938	2,818	977	7	52	15,044	5,786	1,902
1973	2,130	1,478	10,180	1,228	1,742	2,186	802	179	67	15,159	4,833	2,222
1974	2,243	1,122	9,369	955	1,526	2,839	768	1	120	13,690	5,253	2,166
1975	81	1,374	967	1,033	864	2,867	133	12,180	86	13,199	6,386	1,598
1976	1,973	1,408	8,267	743	1,061	2,034	601	40	16	12,423	3,720	519
1977	184	1,706	1,229	1,487	907	2,686	122	13,562	105	15,456	6,532	378
1978	2,812	2,864	8,522	3,591	2,286	2,246	676	341	382	18,062	5,658	301
1979	6,565	2,750	10,495	1,748	2,325	2,550	1,646	229	379	21,741	6,946	78
1980	5,205	3,325	9,899	1,561	3,571	4,684	2,278	47	166	20,023	10,712	541
1981	4,767	2,114	12,097	1,830	2,413	5,072	2,031	419	599	21,051	10,290	179
1982	5,255	2,922	10,451	2,079	3,715	4,571	2,009	538	1,349	20,956	11,933	245
1983	3,437	1,690	8,537	2,497	3,160	3,787	1,674	1,826	2,543	16,891	12,258	320
1984	2,255	2,251	6,192	1,655	2,244	2,959	1,414	3,583	2,698	14,110	11,141	277
1985	3,006	1,199	5,438	1,026	1,999	2,301	1,511	3,608	1,364	12,236	9,216	47
1986	2,914	1,762	4,670	544	1,754	1,802	1,500	4,469	557	11,748	8,224	68
1987	2,676	1,611	4,777	1,131	1,240	858	1,207	5,116	360	12,783	6,179	29
1988	1,502	1,086	5,458	1,271	1,124	850	1,103	7,990	142	14,814	5,711	11
1989	1,370	1,019	5,506	2,820	1,360	1,112	915	5,267	478	13,855	5,994	38
1990	1,846	764	7,915	1,746	2,238	1,721	1,722	5,404	326	15,551	8,119	222
1991	2,552	1,584	8,963	2,440	2,763	4,243	2,560	2,246	307	17,275	10,383	91
1992	1,523	1,818	10,347	1,455	2,919	3,352	1,503	2,876	278	17,556	8,515	9
1993	1,364	1,646	4,845	1,436	1,959	2,428	1,399	760	189	9,924	6,102	0
1994	828	561	4,414	1,128	1,662	1,883	892	1,540	137	8,321	4,724	0
1995	293	696	1,737	1,586	1,306	1,032	510	1,528	79	5,349	3,418	0
1996	466	813	2,787	1,484	1,608	1,659	930	654	171	6,055	4,517	0
1997	453	837	2,213	1,327	1,793	2,240	1,070	1,303	183	5,943	5,479	0
1998	477	907	1,634	1,796	983	1,284	606	331	151	5,064	3,105	0
1999	397	584	1,548	1,288	956	778	408	111	121	3,817	2,373	0
2000	291	395	1,433	1,198	1,071	680	413	151	124	3,317	2,439	0
2001	257	535	1,049	1,395	985	814	441	125	106	3,236	2,471	0
2002	230	461	873	1,491	1,152	924	458	125	155	3,055	2,814	0
2003	185	419	690	1,276	719	1,094	690	275	273	2,570	3,051	0
2004	84	247	354	1,218	925	921	705	285	254	1,904	3,090	
2005	61	296	378	800	705	495	353	110	182	1,535	1,845	0

Table 3. Monthly landings for 4X cod.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unknown	Calendar year	Fishing year
1960	119	428	235	388	1,565	1,329	2,924	1,365	1,703	934	662	417	0	12,069	
1961	225	298	246	597	964	2,324	2,527	1,397	1,250	1,299	880	416	0	12,423	
1962	63	108	363	904	1,181	1,984	3,473	1,846	1,988	1,157	926	556	0	14,549	
1963	309	122	309	577	1,564	2,896	2,570	2,660	1,933	1,714	777	359	0	15,790	
1964	474	320	832	1,690	1,727	3,182	3,592	2,856	2,417	2,362	899	367	349	21,067	
1965	392	367	1,229	1,881	2,603	3,724	4,694	2,634	2,708	2,377	927	685	0	24,221	
1966	911	755	838	2,061	2,034	3,419	4,299	3,323	2,555	2,470	910	588	0	24,163	
1967	874	823	820	1,462	2,304	5,155	4,210	4,052	3,334	2,962	1,304	513	0	27,813	
1968	871	1,107	1,406	2,377	3,121	5,009	4,952	4,116	2,742	3,037	1,328	774	0	30,840	
1969	1,876	1,694	1,071	1,845	2,160	4,176	3,722	2,797	1,943	1,483	827	518	0	24,112	
1970	805	500	617	970	2,024	2,745	2,775	2,279	1,969	1,874	921	541	0	18,020	
1971	526	848	584	814	1,725	3,939	3,328	2,483	2,487	1,902	1,110	555	0	20,301	
1972	862	633	473	744	1,258	3,832	3,982	2871	2038	2663	925	250	0	20,531	
1973	1,009	925	514	1,056	1,381	3,919	2,937	2,623	2,264	1,544	818	1,001	0	19,991	
1974	771	397	399	695	1,335	3,583	3,150	2,538	1,968	1,765	877	1,464	0	18,942	
1975	648	169	394	712	3,223	3,250	3,355	2,647	1,796	1,457	668	1,267	0	19,586	
1976	363	555	376	581	1,220	2,824	2,869	2,064	1,968	1,399	782	1,140	0	16,141	
1977	580	940	861	1,580	2,232	3,782	3,366	2,444	1,740	2,048	1,443	973	0	21,989	
1978	862	2,042	911	1,371	1,987	3,411	3,379	2,920	2,454	1,473	1,085	1,828	0	23,723	
1979	889	752	1,973	1,400	1,846	4,276	3,638	3,555	3,218	2,233	2,992	1,935	0	28,707	
1980	706	2,188	1,704	2,485	3,317	5,316	3,433	3,346	2,603	2,876	1,547	1,756	0	31,277	
1981	1,649	2,451	2,529	1,533	2,881	4,093	3,845	4,067	2,253	3,119	1,728	1,373	0	31,521	
1982	757	2,390	2,569	1,491	3,415	5,109	4,734	3,258	3,540	2,890	1,244	1,737	0	33,134	
1983	1,713	1,654	1,648	1,888	2,743	5,713	4,554	2,832	3,183	1,787	1,037	719	0	29,471	
1984	1,798	2,021	752	817	1,796	3,471	3,688	4,567	2,773	1,668	1,201	976	0	25,528	
1985	779	1,699	956	1,268	1,974	2,586	3,199	2,650	2,737	1,801	787	1,063	0	21,499	
1986	904	1,633	1,775	1,450	1,437	1,939	2,739	1,995	2,576	1,714	771	1,107	0	20,040	
1987	1,208	1,837	1,242	1,059	1,870	2,778	2,663	1,821	1,679	1,403	910	535	0	19,005	
1988	2,104	1,531	535	939	1,620	2,931	3,104	2,122	2,524	1,441	636	1,050	0	20,537	
1989	2,150	2,347	1,362	1,707	1,292	3,562	1,830	1,772	1,535	1,278	637	413	0	19,885	
1990	2,619	2,027	707	778	1,560	3,104	3,751	3,123	2,598	1,689	1,158	790	0	23,904	
1991	2,023	2,651	993	1,666	2,322	3,167	3,963	2,881	2,967	2,208	1,650	1,258	0	27,749	
1992	2,088	1,740	1,297	1,502	1,685	3,622	3,366	2,803	2,625	2,353	1,478	1,521	0	26,080	
1993	657	903	994	996	1,617	2,312	2,834	2,221	1,804	1,048	562	78	0	16,026	
1994	734	972	547	847	824	1,771	2,246	1,503	1,267	1,154	726	454	0	13,045	
1995	610	229	317	827	574	1,236	1,771	774	1,071	521	276	561	0	8,767	
1996	503	331	446	531	819	1,755	1,805	1,317	880	887	679	619	0	10,572	
1997	98	362	378	806	644	1,440	1,779	1,382	1,548	1,424	710	668	0	11,239	
1998	285	348	402	313	511	941	1,272	953	1,125	770	520	729	0	8,169	
1999	186	105	124	330	414	1,047	1,269	856	854	445	324	235	0	6,190	7,216
2000	215	255	556	113	368	906	1,104	755	545	507	324	107	0	5,755	5,834
2001	361	103	641	315	449	745	870	672	594	470	318	169	0	5,707	5,908
2002	376	274	561	624	493	673	837	742	563	358	229	141	0	5,869	5,798
2003	296	160	684	289	474	435	559	764	790	562	412	209		5,633	5,480
2004	119	246	622	398	456	453	603	567	606	407	253	264		4,994	4,730
2005	202	288	233	347	280	241	451	569	427	341				3,380	2,657

" landings from 2000 onward represent quota years running from April - April

* total landings for new quota year from quota monitoring reports

** landings reported to October 21th 2005

Table 4. Proportion of groundfish quotas landed in the 4X fishery by gear sector.

2000 Quota Report	cod	haddock	pollock
FIXED < 45'	97%	97%	80%
MOBILE <65' (ITQ)	107%	103%	77%
VESSELS >100'	90%	92%	29%

2001 Quota Report	cod	haddock	pollock
FIXED < 45'	96%	77%	82%
MOBILE <65' (ITQ)	104%	100%	73%
VESSELS >100'	89%	95%	28%

2002 Quota Report	cod	haddock	pollock
FIXED < 45'	96%	94%	72%
MOBILE <65' (ITQ)	102%	99%	91%
VESSELS >100'	65%	80%	61%

2003 Quota Report	cod	haddock	pollock
FIXED < 45'	84%	60%	74%
MOBILE <65' (ITQ)	104%	100%	97%
VESSELS >100'	91%	93%	87%
Aboriginal Fishery	98%	82%	70%

2004 Quota Report	cod	haddock	pollock
FIXED < 45'	70%	30%	78%
MOBILE <65' (ITQ)	91%	74%	99%
VESSELS >100'	85%	66%	91%
Aboriginal Fishery	88%	69%	77%

2005 Quota Report	cod	haddock	pollock
FIXED < 45'	57%	30%	79%
MOBILE <65' (ITQ)	50%	51%	83%
VESSELS >100'	15%	11%	62%
Aboriginal Fishery	41%	36%	56%

Landings To October 27th 2005

cod	haddock	pollock
61%	24%	73%
58%	40%	68%
29%	16%	62%
46%	22%	33%

Landings To November 5th 2004

Table 5a. Number of fishing vessels reporting landings of cod, haddock, Pollock or white hake annually.

Year	Otter Trawl	Gill Net	Longline	Handline
1996	142	205	528	779
1997	142	197	497	657
1998	129	163	398	422
1999	129	126	357	354
2000	121	101	376	326
2001	112	97	366	201
2002	113	110	381	162
2003	108	103	339	92
2004	103	98	312	59
2005*	88	88	262	37

Table 5b. Fishing Days by gear type.

Year	Gill Net	Longline	Handline
1996	4912	5210	9880
1997	6281	6179	9650
1998	4178	5352	5721
1999	3370	4156	4234
2000	2321	3794	3287
2001	2116	3895	2093
2002	2253	4232	1390
2003	2432	3960	711
2004	2237	3089	468
2004*	2060	2615	430
2005*	1909	2122	234

*effort to October 4th.

Table 6. Observer coverage in the 4X groundfish fishery.

year		otter trawl Tonnage	otter trawl proportion	longline Tonnage	longline proportion
2001	observed	45.4	3.80%	11.1	0.74%
	landed	1188		1500	
2002	observed	0.266	0.01%	6.3	0.30%
	landed	1777		1867	
2003	observed	20.2	0.79%	6.9	0.82%
	landed	2540		842	
2004	observed	88.3	3.60%	12.3	0.99%
	landed	2453		1243	
2005	observed	26.1	2.16%	3.1	0.88%
	landed	1207		351	

Table 7. Construction of catch-at age for 4X cod in the first half of 2005

Gear	Area	Number of samples	Number Measured	Landings (t)	Age-length key
Otter trawl	Fundy	15	3760	960	Fundy 213 ages
Gill net		4	1319	275	
Hook and line		2	503	91	
Otter trawl	Shelf	8	1883	153	Shelf 201 ages
Gill net		1	204	14	
Hook and line		4	874	93	

Table 8. Catch at age (numbers in thousands) for 4X cod.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+
1980	0	837	6,054	2,358	1,742	1,135	442	261	91	60	19	17	5	13,021	12,183	6,129
1981	0	818	3,870	4,265	1,844	1,045	587	297	184	75	39	19	19	13,061	12,244	8,373
1982	0	904	2,885	4,414	3,060	912	393	279	146	86	41	25	15	13,160	12,255	9,371
1983	9	1,031	3,689	2,433	2,057	1,205	459	204	120	76	36	10	10	11,330	10,299	6,610
1984	33	917	2,393	3,081	1,930	965	465	176	63	49	29	18	5	10,090	9,173	6,781
1985	0	711	1,674	1,569	2,324	1,284	514	194	71	53	18	7	6	8,425	7,715	6,041
1986	0	251	2,789	1,941	994	1,008	409	200	93	50	23	20	10	7,788	7,537	4,748
1987	0	861	902	2,053	1,087	523	511	236	140	66	33	9	7	6,428	5,567	4,665
1988	0	403	3,517	1,659	1,553	656	178	192	85	53	28	6	9	8,338	7,935	4,418
1989	17	655	2,560	3,656	632	562	163	79	60	19	10	10	2	8,408	7,753	5,193
1990	0	144	2,863	2,805	2,462	497	279	78	40	38	14	15	1	9,235	9,091	6,228
1991	2	391	1,535	5,092	1,777	1,364	215	156	32	16	28	15	6	10,626	10,235	8,700
1992	0	751	3,391	1,878	3,276	878	513	63	50	16	9	4	0	10,828	10,077	6,6...
1993	0	881	3,490	2,045	660	672	186	90	14	14	5	0	0	8,056	7,176	3,686
1994	0	475	2,280	2,233	887	195	181	42	18	0	2	0	0	6,314	5,838	3,558
1995	0	135	2,146	1,081	582	130	28	40	11	5	0	0	0	4,158	4,023	1,877
1996	0	50	883	2,594	441	212	29	16	8	2	1	1	0	4,237	4,187	3,304
1997	0	59	1,126	1,556	1,193	199	82	16	2	6	1	3	0	4,243	4,184	3,058
1998	0	234	886	1,021	615	441	54	20	6	2	3	1	1	3,284	3,050	2,164
1999	0	72	834	543	347	264	120	20	7	0	0	1	0	2,210	2,138	1,303
2000	0	218	575	905	247	189	66	27	8	1	1	0	0	2,237	2,019	1,444
2001	0	114	1,187	595	378	75	40	17	12	1	0	0	0	2,420	2,306	1,119
2002	0	29	435	1,035	245	142	28	16	10	2	1	0	0	1,942	1,913	1,478
2003	0	67	338	627	472	97	71	27	2	1	2	0	0	1,702	1,636	1,298
2004	0	18	883	400	309	155	19	22	5	1	1	0	0	1,813	1,796	912
2005*		1	34	326	76	41	19	5	1	0				503	502	469

* Includes Jan. - June 30.

Table 9. Weights-at-age for 4X cod by area.

		1	2	3	4	5	6	7	8	9	10	11	12
	1983		0.76	1.22	1.81	2.50	3.93	6.09	8.22	10.76	11.83	12.22	16.59
	1984		0.96	1.30	1.69	2.34	3.37	4.68	6.83	8.60	11.06	13.21	14.03
	1985		0.60	1.07	1.47	2.00	3.06	4.55	6.70	6.89	9.00	14.16	15.66
	1986		0.78	1.13	1.63	2.21	3.47	4.69	7.15	8.83	8.81	13.11	13.10
	1987		1.23	1.40	1.83	2.61	3.46	4.99	7.33	8.36	10.66	11.80	15.85
Scotian	1988		0.94	1.30	1.90	2.69	3.98	5.23	8.06	9.88	10.93	13.05	16.04
Shelf	1989	0.78	1.23	1.57	2.21	2.75	3.96	4.88	7.86	9.46	11.95	15.04	14.81
	1990		0.82	1.29	1.97	2.86	3.72	5.59	8.10	10.46	11.93	14.12	15.24
	1991		0.76	1.13	1.73	2.50	3.54	5.08	6.44	9.44	11.19	13.73	15.74
	1992		0.78	1.14	1.63	2.58	3.58	4.44	6.50	8.37	12.10	14.50	19.15
	1993		0.68	1.25	1.62	2.24	3.44	4.67	7.01	9.13	10.97	18.08	
	1994		0.76	1.04	1.92	2.41	3.15	4.97	5.21	9.28	15.98	13.56	
	1995		0.86	1.23	1.72	3.26	4.09	4.69	7.23	9.18	13.33	16.33	
	1996		0.75	1.21	2.06	2.96	4.77	5.53	6.39	9.80	12.02	10.12	
	1997		1.17	1.22	1.83	3.31	4.49	6.04	8.83	9.99	11.14	13.58	8.71
	1998		0.86	1.12	1.71	2.54	4.42	4.72	7.33	9.76	9.66	10.83	16.17
	1999		1.00	1.71	2.32	2.83	4.03	5.43	8.26	10.70	13.24	11.35	16.54
	2000		0.93	1.50	2.32	2.85	3.14	4.05	5.57	9.44	10.98	10.25	12.53
	2001		0.99	1.62	2.19	3.65	4.11	5.12	6.62	8.19	8.72	11.05	0.00
	2002		0.75	1.29	2.39	3.08	4.55	5.70	7.24	7.32	8.54	7.61	
	2003		0.78	1.45	2.14	3.63	5.08	6.36	7.17	10.38	12.60	12.74	
	2004		0.75	1.41	2.48	3.77	4.95	5.33	7.26	11.15		14.04	
	Mean	0.78	0.87	1.30	1.93	2.80	3.92	5.13	7.15	9.33	11.27	12.93	14.01
	1983	0.38	0.86	1.48	2.18	3.30	4.88	6.38	8.62	9.92	12.19	14.23	20.63
	1984	0.39	0.93	1.62	2.48	3.52	4.67	6.98	7.94	12.10	13.45	4.75	
	1985	0.37	0.84	1.48	2.26	3.43	4.53	6.54	9.45	11.46	15.12	18.23	19.52
	1986	0.37	0.80	1.41	2.33	4.30	6.24	7.36	8.18	9.50	14.25	7.99	11.98
	1987		0.84	1.57	2.56	4.17	5.33	7.04	7.92	7.94	14.31	18.56	
Bay of	1988		0.86	1.46	2.24	4.09	5.36	8.99	10.14	8.89	14.69		
Fundy	1989	0.33	0.76	1.52	2.59	3.60	6.33	7.25	10.32	10.55	14.57		11.66
	1990		1.05	1.69	2.69	3.77	4.37	7.31	8.15	11.32	11.95	12.75	14.74
	1991	0.82	1.04	1.88	2.91	4.26	6.77	8.75	11.02	13.60	14.17	15.10	17.93
	1992		1.18	1.73	2.73	4.49	6.51	8.78	9.93	13.13	14.55	11.10	
	1993		0.90	1.74	2.86	4.74	6.09	7.58	9.18	14.32	16.75	13.85	
	1994		0.98	1.75	3.19	5.72	7.96	9.31	11.61	11.56		17.46	
	1995		1.29	1.91	2.78	4.38	6.01	7.76	9.84	12.49	8.57	14.32	
	1996		1.06	1.70	2.85	4.71	6.12	5.97	10.56	11.05			13.19
	1997		1.17	1.73	2.74	4.28	5.77	8.44	10.30	9.18	12.94	11.07	22.55
	1998		1.16	1.99	3.14	4.49	5.91	8.13	9.20	12.75		14.32	
	1999	0.70	1.31	1.88	2.93	4.44	6.06	7.55	8.93			8.97	14.78
	2000		1.28	2.17	3.49	3.96	5.66	7.80	8.65	11.44	13.67	10.59	11.55
	2001		0.95	2.01	3.46	4.72	6.36	8.15	8.42	11.41	11.88		
	2002		1.33	2.15	3.51	5.27	7.04	8.14	10.13	12.03	18.09		
	2003		1.59	2.08	3.15	5.03	6.08	7.25	13.86	7.62		19.68	
	2004		0.86	1.75	2.68	4.17	5.44	7.33	7.52	8.12	8.71	14.66	14.01
	Mean	0.48	1.05	1.76	2.81	4.31	5.89	7.67	9.54	10.97	13.52	13.39	15.68

Table 10a. RV survey stratified numbers for 4X cod

Age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	208	141	1085	4226	2369	1480	946	389	0	77	37	0	6
1984	0	820	5746	3390	2362	1820	688	482	63	58	25	0	0
1985	69	495	8760	4331	1527	1451	766	483	267	165	13	0	26
1986	25	768	1333	2920	1226	314	549	448	217	97	19	0	51
1987	6	392	2348	618	1180	528	260	245	304	75	40	63	0
1988	260	2630	3926	9246	1496	1548	496	210	244	91	38	13	0
1989	309	794	6089	3420	2549	420	489	108	27	82	37	14	0
1990	28	515	873	5523	2463	2321	240	414	80	42	0	21	27
1991	34	614	1727	1131	3086	1094	751	128	116	19	21	12	0
1992	35	252	2731	1569	681	1710	471	460	124	85	0	0	0
1993	14	369	955	2518	925	129	265	52	61	0	6	41	0
1994	748	1258	3313	2739	1605	449	36	195	88	70	0	32	65
1995	1212	122	847	4779	1477	598	274	94	91	34	42	7	0
1996	31	339	839	2048	5527	880	753	148	0	56	15	0	0
1997	95	349	569	1189	1444	2462	321	194	100	0	57	0	0
1998	65	211	1929	1808	1418	1022	1371	225	116	6	0	0	0
1999	869	382	787	1291	882	850	194	297	46	0	0	0	0
2000	3324	432	1497	830	999	409	325	157	148	0	0	0	21
2001	908	150	1984	2272	1476	816	347	217	148	31	0	0	0
2002	110	5196	1990	2565	2472	496	302	121	19	98	0	0	0
2003	715	499	3005	544	1102	745	189	78	20	19	0	0	0
2004	167	31	272	2977	319	324	113	27	8	0	0	0	0
2005	54	250	1741	368	1820	223	208	35	0	35	0	17	0

Table 10b. RV survey stratified numbers for cod on the Scotian Shelf

Age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	136	107	571	3157	1914	937	546	146	0	13	0	0	6
1984	0	354	1417	1376	1201	1507	538	416	0	36	0	0	0
1985	69	90	837	834	343	456	483	314	77	0	13	0	26
1986	0	19	616	947	509	151	435	349	195	0	19	0	51
1987	6	79	1229	305	325	250	106	68	187	26	0	0	0
1988	27	793	1602	5143	1317	887	228	107	57	91	38	13	0
1989	301	136	2910	1789	1723	230	227	89	0	30	18	14	0
1990	28	151	213	2187	1419	1319	113	108	0	0	0	0	7
1991	34	147	1107	599	1833	722	545	80	7	19	0	0	0
1992	35	108	547	981	359	946	405	224	104	29	0	0	0
1993	14	33	296	664	502	80	82	32	61	0	6	41	0
1994	92	380	1073	626	610	268	19	51	50	50	0	0	33
1995	216	33	534	2107	1059	248	229	47	32	34	0	7	0
1996	31	207	374	1307	2378	303	429	148	0	24	15	0	0
1997	30	126	399	560	850	1225	128	109	100	0	26	0	0
1998	39	0	441	599	495	557	503	97	55	6	0	0	0
1999	677	69	330	730	675	736	165	98	0	0	0	0	0
2000	3263	86	151	246	265	230	223	144	148	0	0	0	21
2001	908	150	487	1441	477	406	22	60	0	31	0	0	0
2002	110	59	247	430	547	306	141	49	0	25	0	0	0
2003	258	11	234	210	227	144	15	30	0	0	0	0	0
2004	122	31	74	480	192	205	34	27	8	0	0	0	0
2005	11	159	924	142	632	60	57	15	0	35	0	17	0

Table 10c. RV survey stratified numbers for cods in the Bay of Fundy and Gulf of Maine

age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	71	34	514	1069	456	543	400	244	0	63	37	0	0
1984	0	466	4328	2015	1161	313	150	66	63	23	25	0	0
1985	0	404	7923	3497	1184	995	283	169	190	165	0	0	0
1986	25	749	718	1974	717	163	114	99	21	97	0	0	0
1987	0	313	1118	313	855	278	154	177	117	49	40	63	0
1988	233	1837	2323	4103	179	661	268	103	187	0	0	0	0
1989	9	658	3179	1632	826	190	262	20	27	52	19	0	0
1990	0	364	660	3335	1044	1002	128	306	80	42	0	21	21
1991	0	466	620	532	1253	372	206	48	109	0	21	12	0
1992	0	144	2184	588	322	765	66	237	21	56	0	0	0
1993	0	336	659	1854	423	49	183	20	0	0	0	0	0
1994	657	878	2240	2113	996	180	16	143	38	20	0	32	32
1995	996	89	313	2671	418	351	45	47	60	0	42	0	0
1996	0	132	465	740	3149	578	324	0	0	32	0	0	0
1997	65	223	170	629	594	1236	194	85	0	0	31	0	0
1998	26	211	1488	1209	923	465	868	128	61	0	0	0	0
1999	192	313	457	561	207	115	29	199	46	0	0	0	0
2000	61	346	1346	585	734	179	102	12	0	0	0	0	0
2001	1262	0	567	1449	474	240	22	0	0	0	0	0	0
2002	0	4269	1743	2143	1954	214	183	73	19	73	0	0	0
2003	457	488	2771	334	875	601	174	49	20	19	0	0	0
2004	45	0	199	2497	127	119	79	0	0	0	0	0	0
2005	43	91	818	226	1187	162	151	20	0	0	0	0	0

Table 11. ITQ survey indices for 4X cod.

4X	0	1	2	3	4	5	6	7	8	9	10
1996	1	302	662	835	737	84	31	6	0	2	0
1997	1	225	232	727	393	265	17	24	6	2	1
1998	16	179	857	619	276	112	112	15	7	0	0
1999	2002	601	700	708	170	98	15	24	5	1	0
2000	5	1063	1039	351	234	62	61	15	13	0	0
2001	907	234	2369	3391	382	142	5	21	5	6	0
2002	37	380	551	510	343	63	35	21	2	4	0
2003	37	283	1099	551	322	167	36	12	4	1	0
2004	7	370	142	746	258	98	48	8	2	3	0
2005	10	176	1196	71	248	18	16	1	0	0	1

FUNDY	0	1	2	3	4	5	6	7	8	9
1996	1	259	487	359	427	61	13	1	0	1
1997	0	207	126	529	204	182	10	17	5	1
1998	16	150	754	493	186	40	69	4	1	0
1999	2000	506	412	526	92	50	8	22	5	0
2000	3	955	738	156	135	21	6	4	4	0
2001	907	115	2120	3196	298	83	2	5	0	0
2002	35	343	97	277	253	25	20	17	2	0
2003	36	278	771	133	213	137	32	9	2	0
2004	6	348	92	361	33	28	16	1	1	1
2005	10	148	703	22	115	8	7	1	0	0

Shelf	0	1	2	3	4	5	6	7	8	9	10
1996	0	43	175	476	310	23	17	5	0	1	0
1997	1	18	106	198	189	83	7	7	1	1	1
1998	0	29	103	126	89	71	44	11	6	0	0
1999	2	95	287	182	78	48	7	2	0	1	0
2000	2	108	301	196	98	42	55	11	9	0	0
2001	0	119	249	195	84	59	3	16	5	6	0
2002	2	37	454	233	89	39	14	4	0	4	0
2003	1	5	328	418	109	30	3	3	2	1	0
2004	1	22	50	385	225	70	32	7	1	2	0
2005	0	28	492	49	133	10	9	0	0	0	0

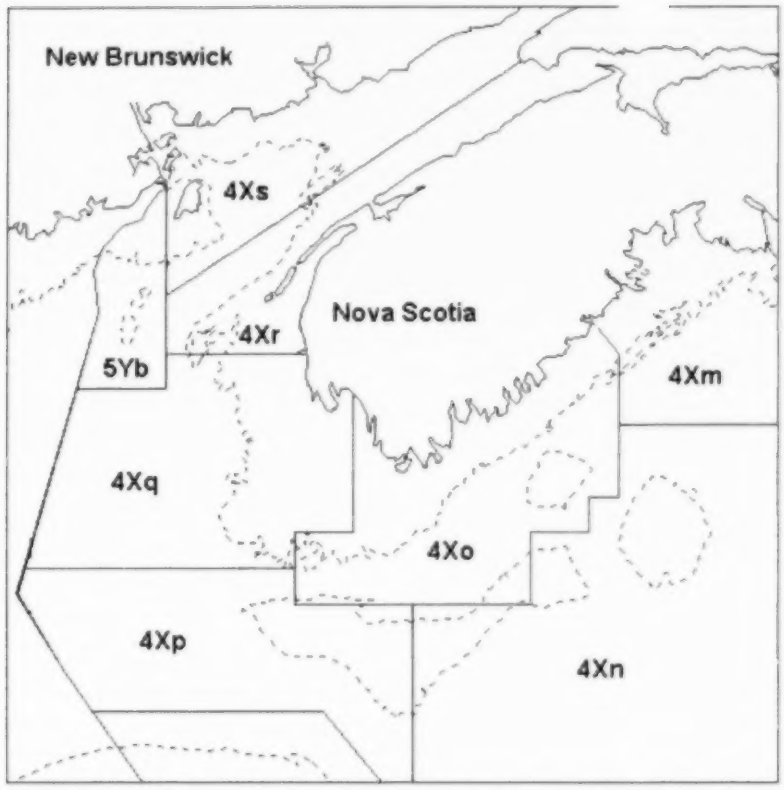

Figure 1. Canadian statistical unit areas in southern Scotian Shelf and Bay of Fundy.

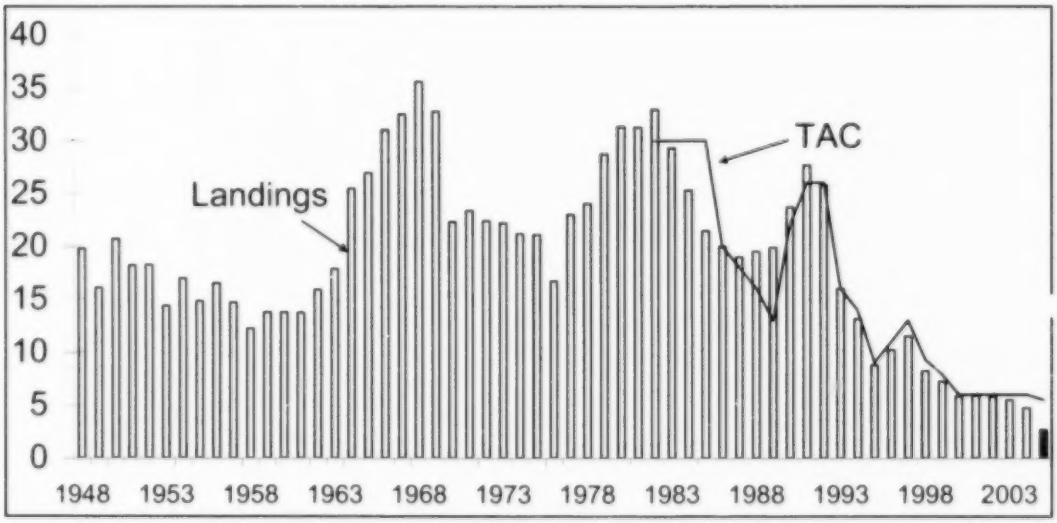

Figure 2. Nominal landings and quota (TAC) of cod in Division 4X and Canadian portion of 5Y by quota year (2005 landings for partial year).

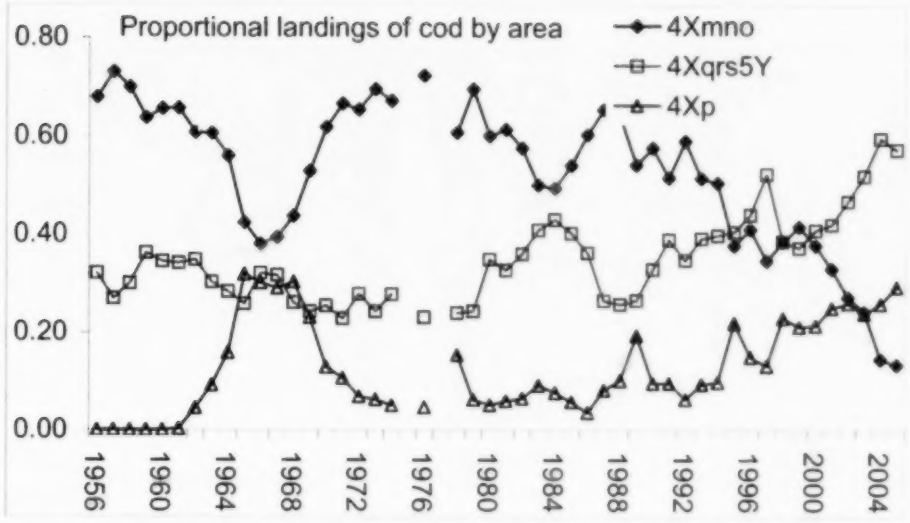

Figure 3. Proportion of 4X cod landings by region.

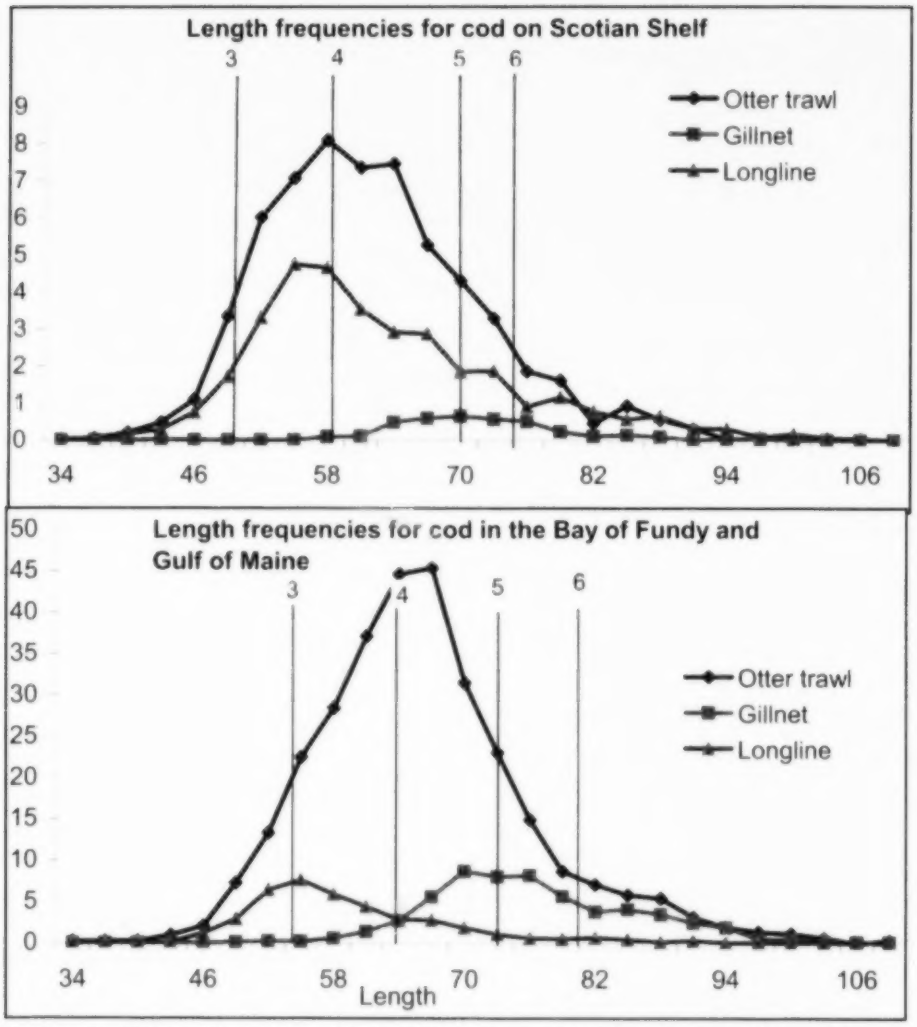

Figure 4. Proportion at length (cm) in commercial landings of 4X cod by area and gear type in 2005. Vertical lines reflect the mean lengths at age for each area.

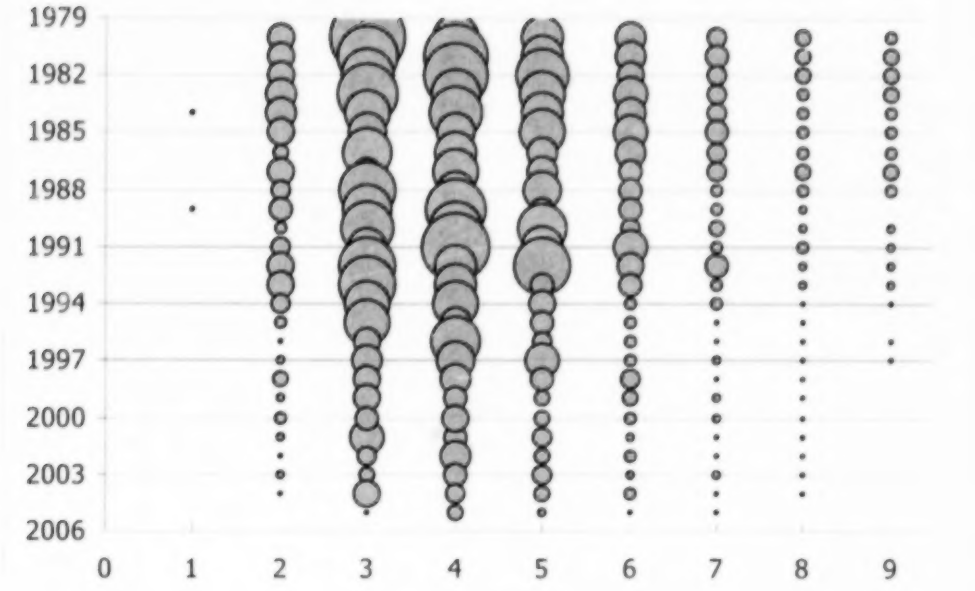

Figure 5. Commercial catch-at-age for 4X cod. Area of circle is proportional to catch in numbers.

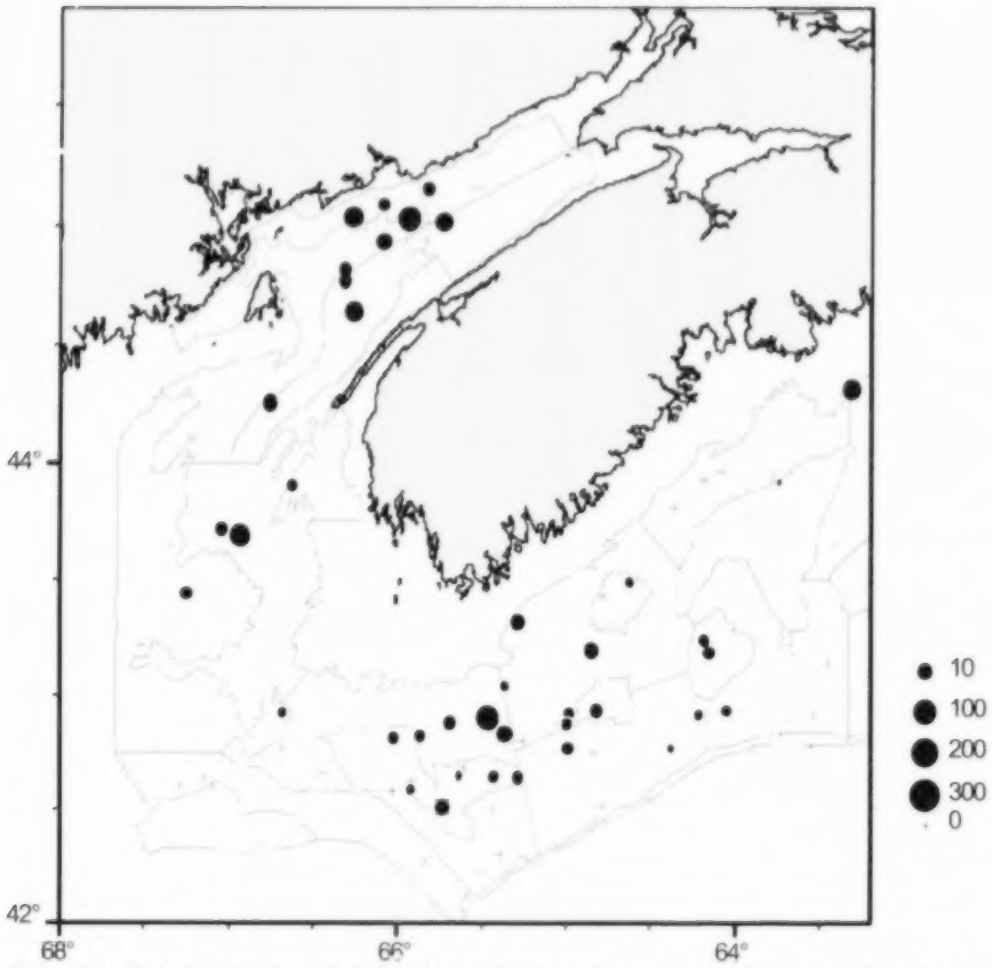

Figure 6. Distribution and magnitude of RV survey catches (Kg) of 4X cod in 2005

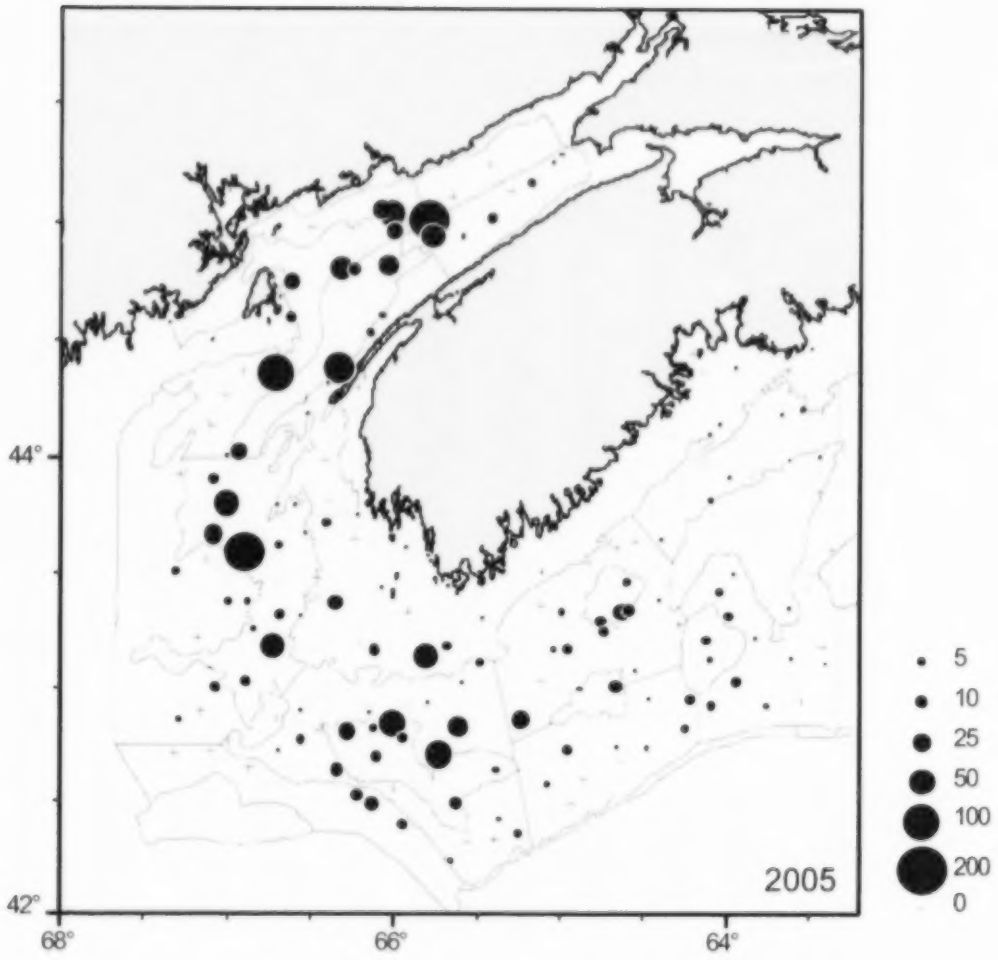

Figure 7. Distribution and magnitude of ITQ survey catches (Kg) of 4X cod in 2005.

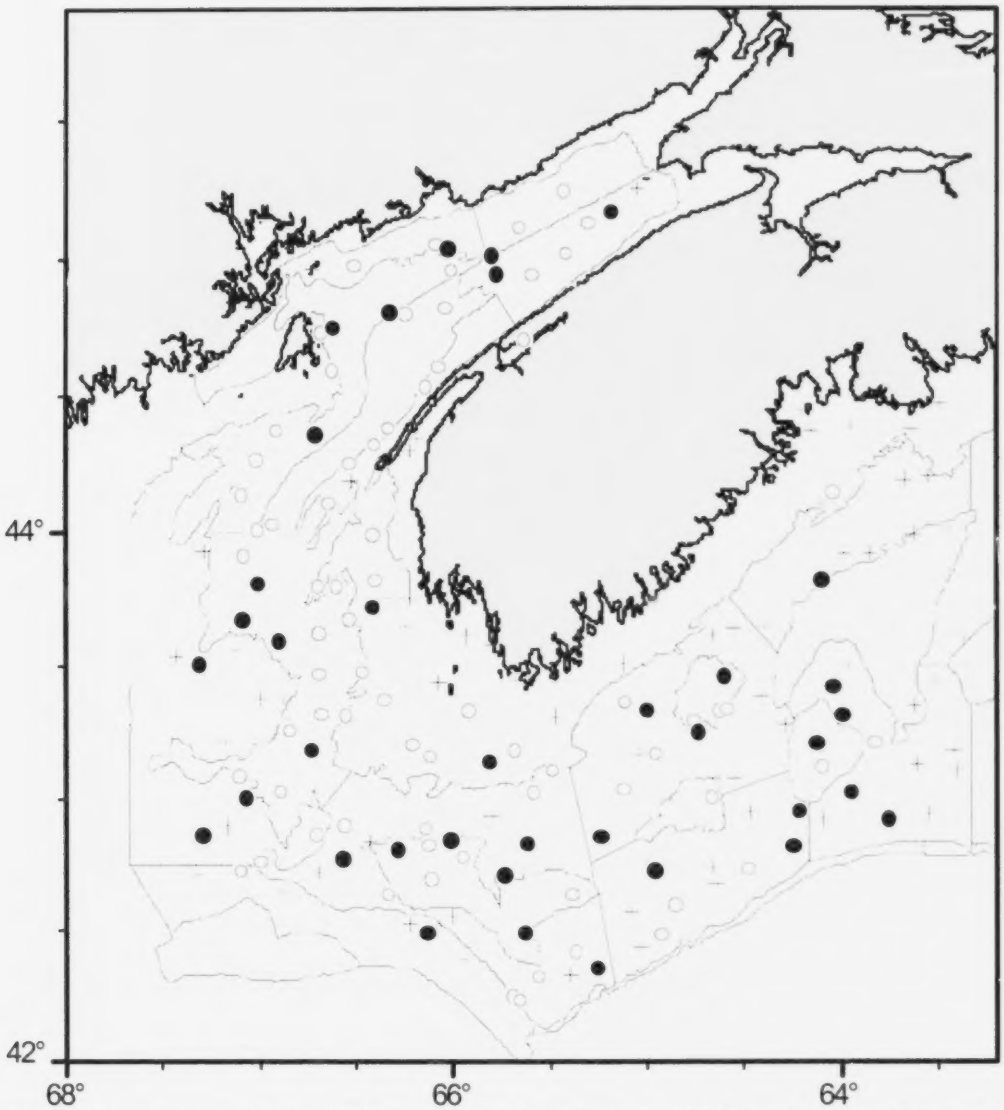

Figure 8. A comparison of ITQ survey cod catches for 2005 with the median value for each station since 1996. • 2005 value>median; + 2005 value is within 1 of the median; o 2005 value<median.

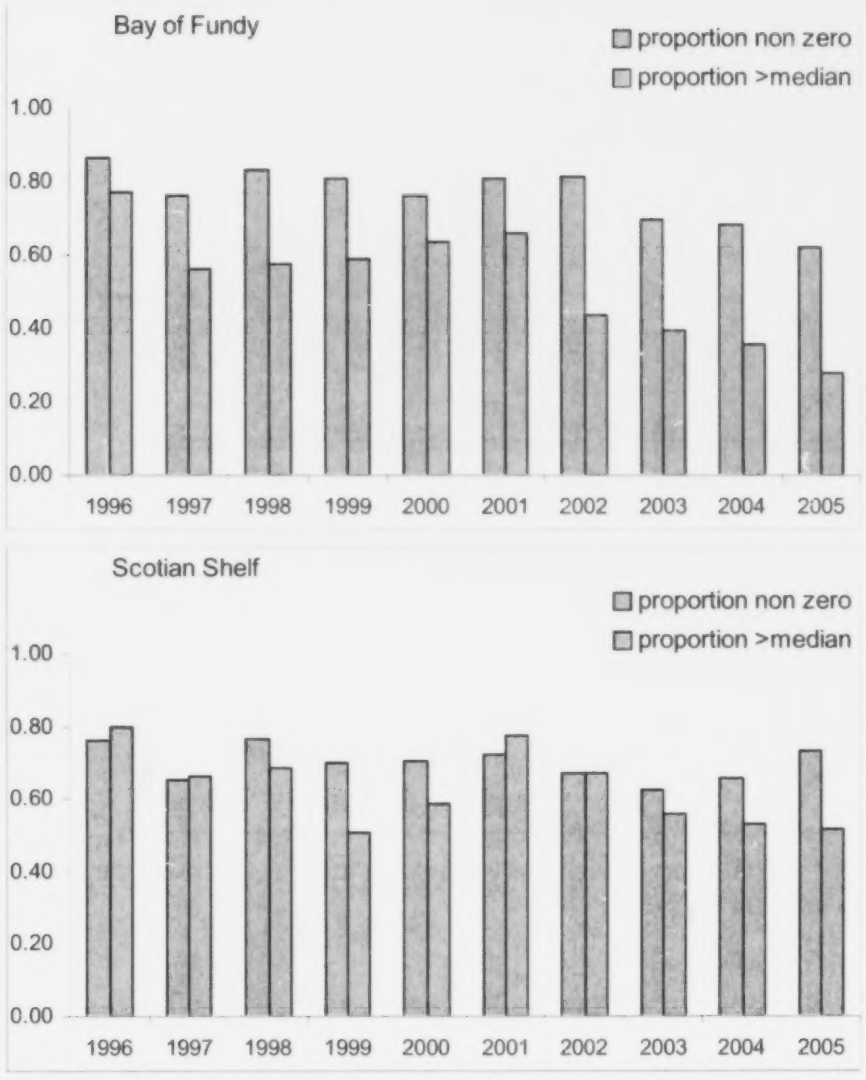

Figure 9. Proportion of ITQ survey stations where cod were caught, and where catch was above the median for that location (1996-2005).

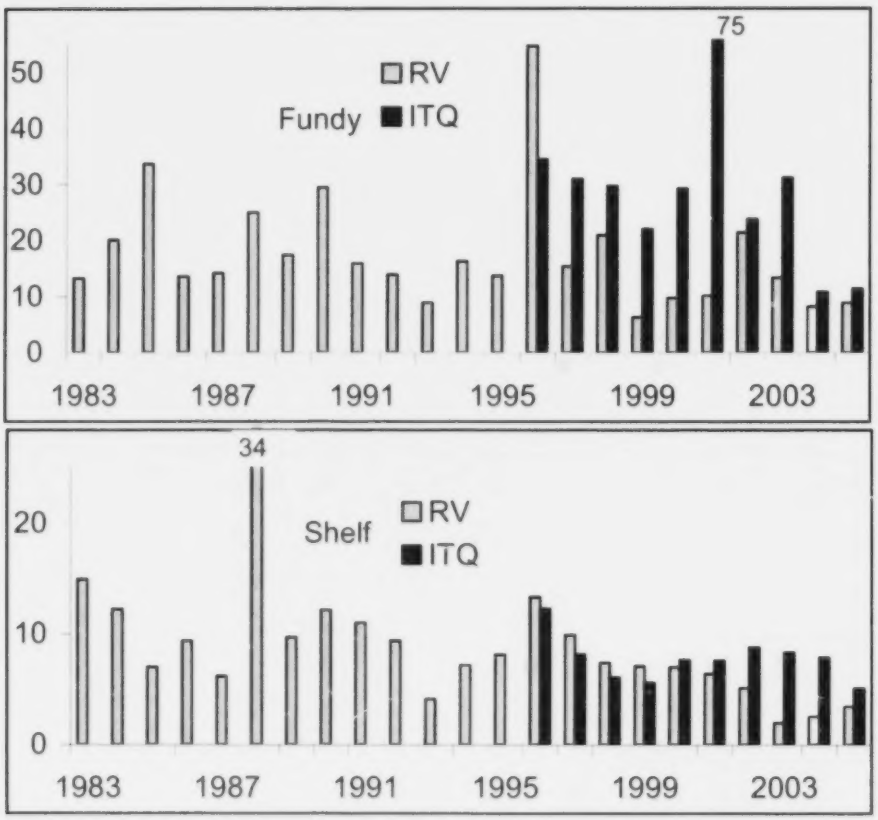

Figure 10. RV and ITQ survey biomass indices (Kg/tow) for 4X cod in the Bay of Fundy and the Scotian Shelf.

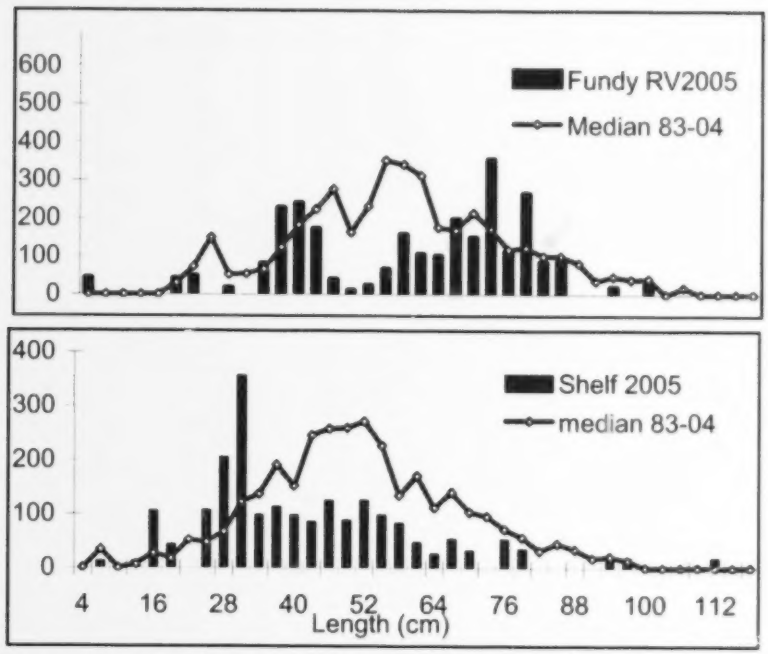

Figure 11. Length frequencies for 4X cod caught in the 2005 RV survey.

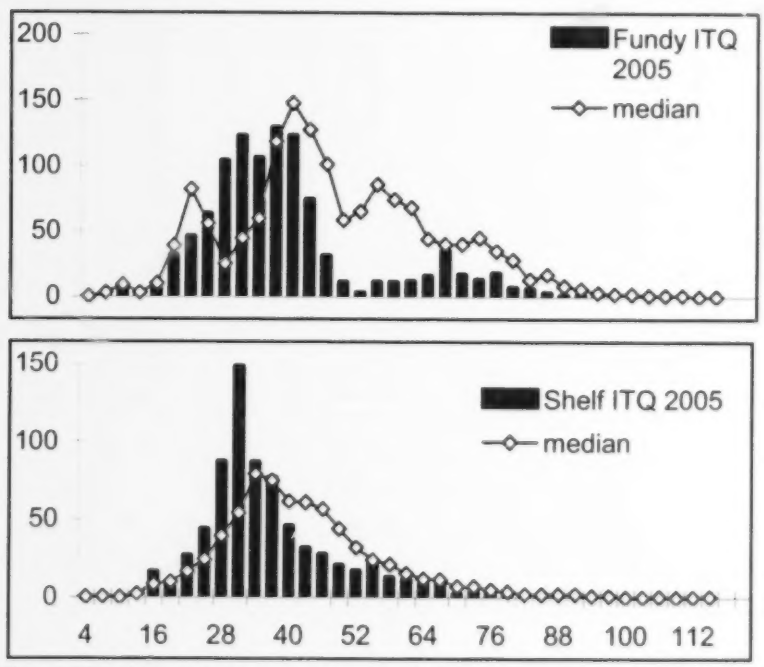

Figure 12. Length frequencies for 4X cod caught in the 2005 ITQ survey.

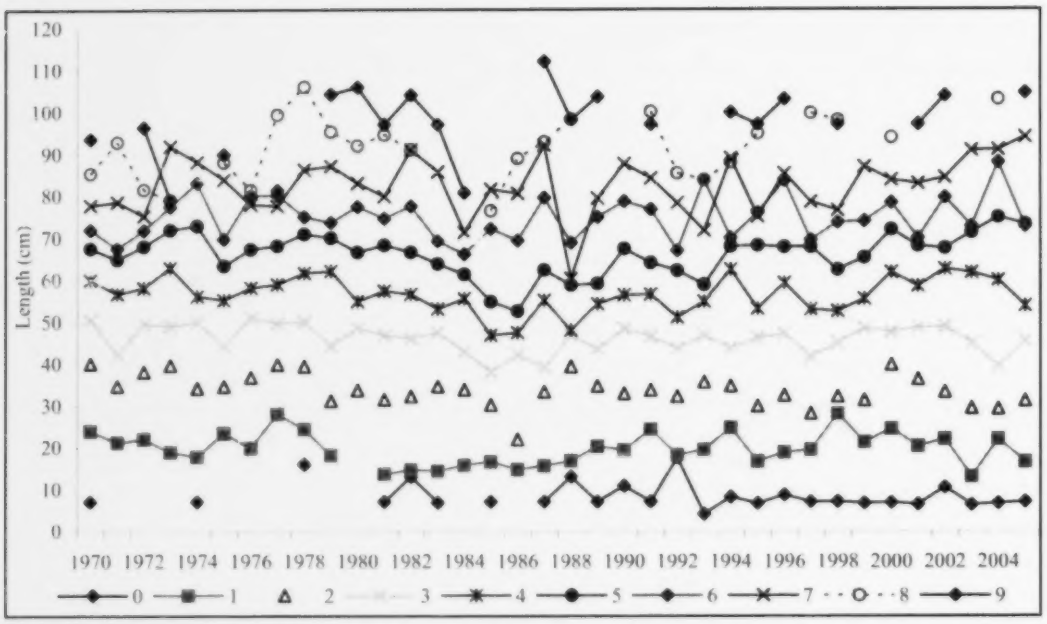

Figure 13a. Lengths-at-age for cod on the Southern Scotian Shelf.

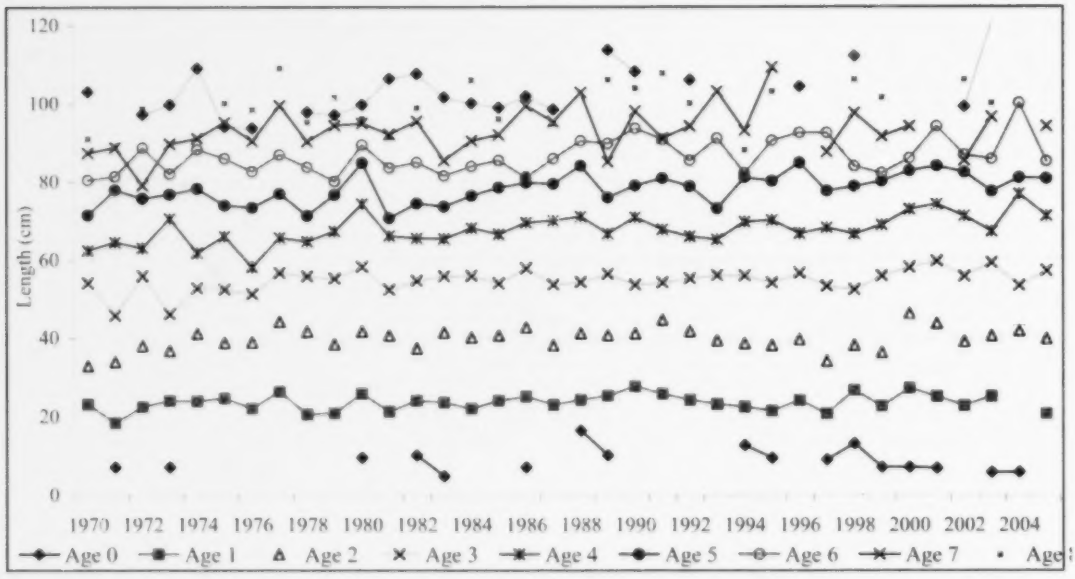

Figure 13b. Lengths-at-age for cod in the Bay of Fundy

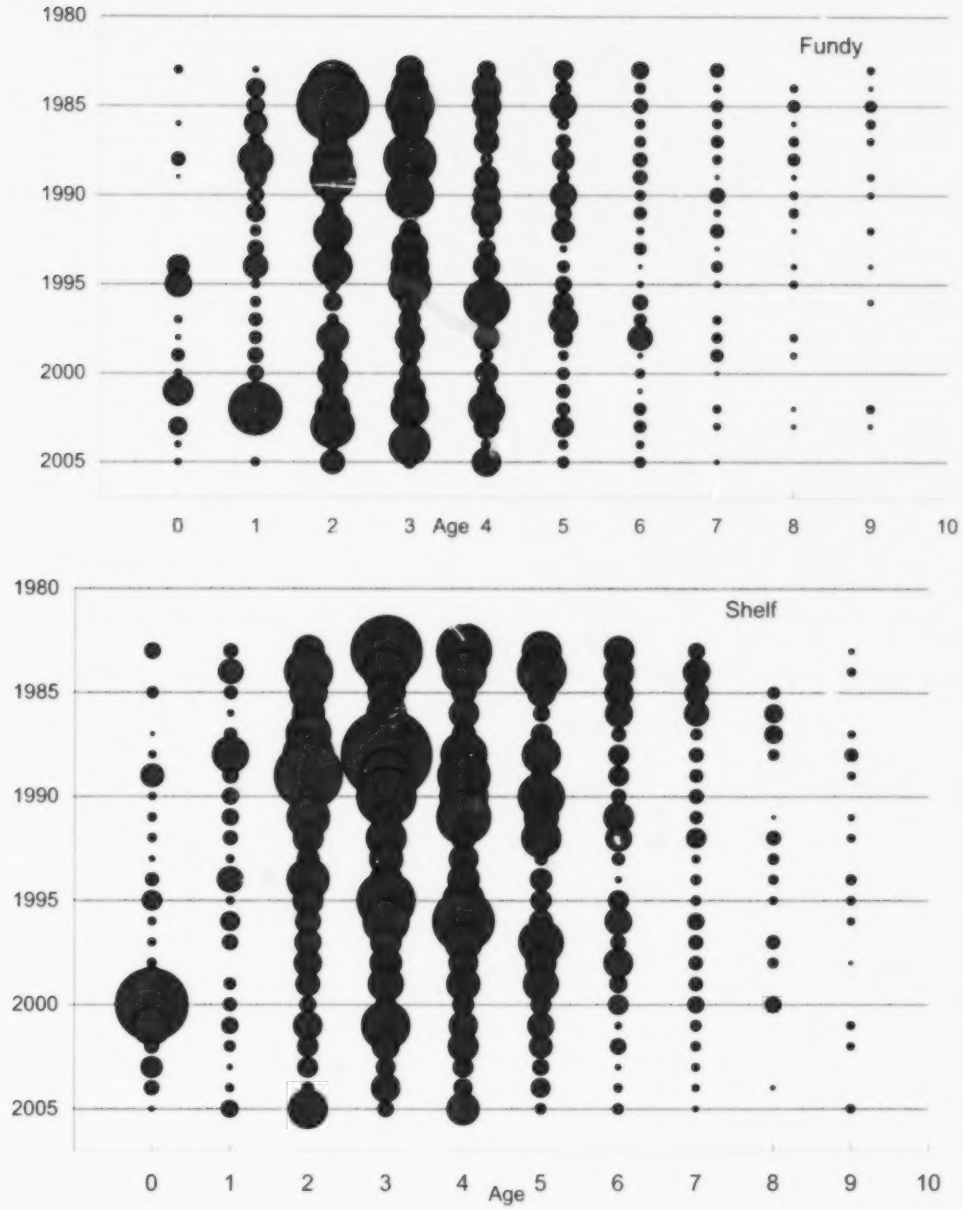

Figure 14. RV survey indices at age by area for 4X cod.

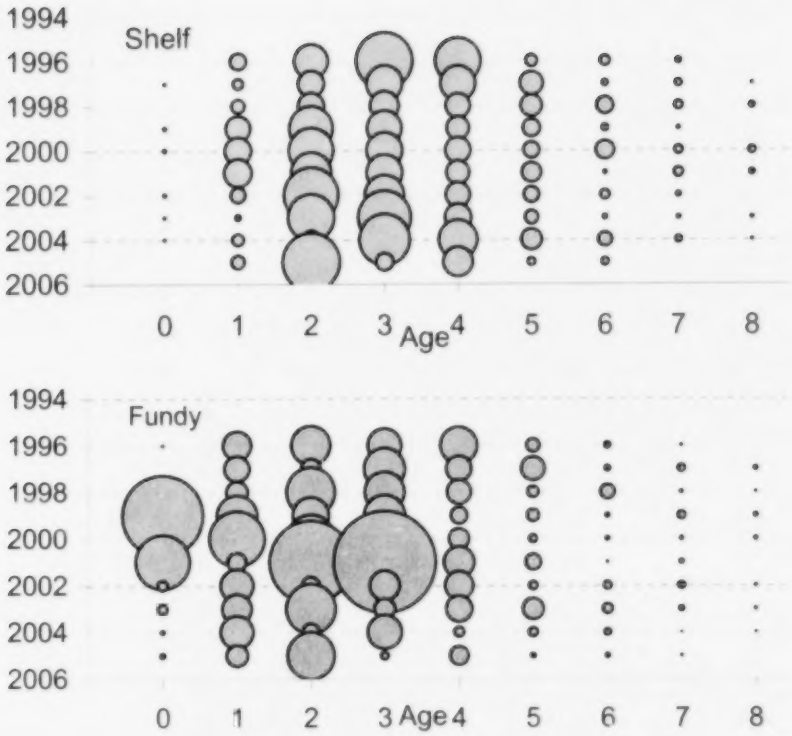

Figure 15. ITQ survey indices at age for 4X cod.

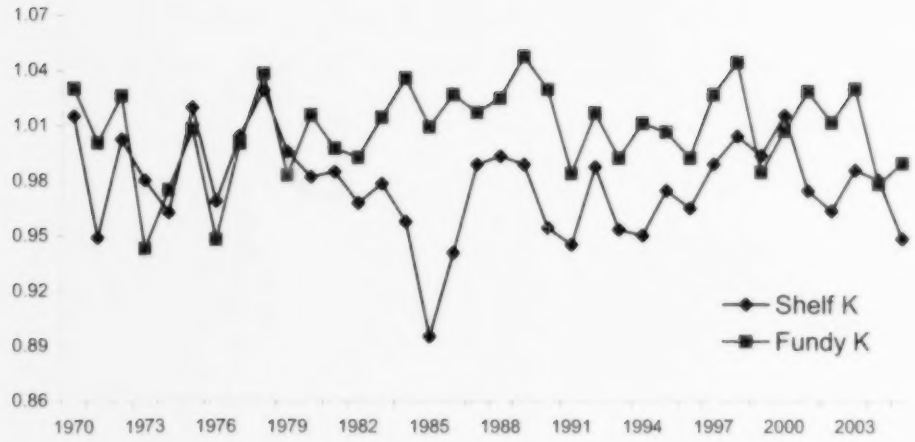

Figure 16. Condition factor (Fulton's K) for 4X cod from the RV survey.

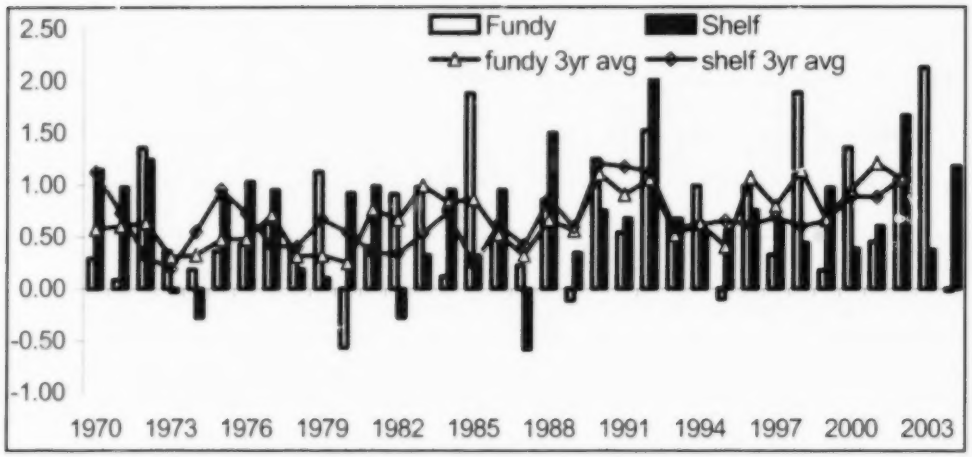

Figure 17. Total mortality estimate (Z) from the RV survey for 4X cod.

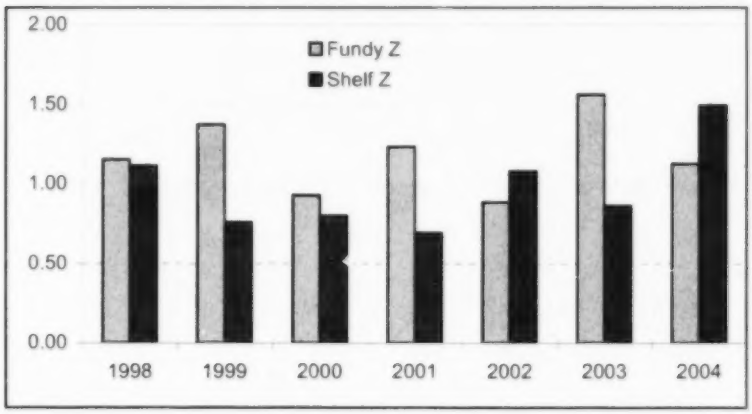

Figure 18. Total mortality estimate (Z) from the ITQ survey for 4X cod.

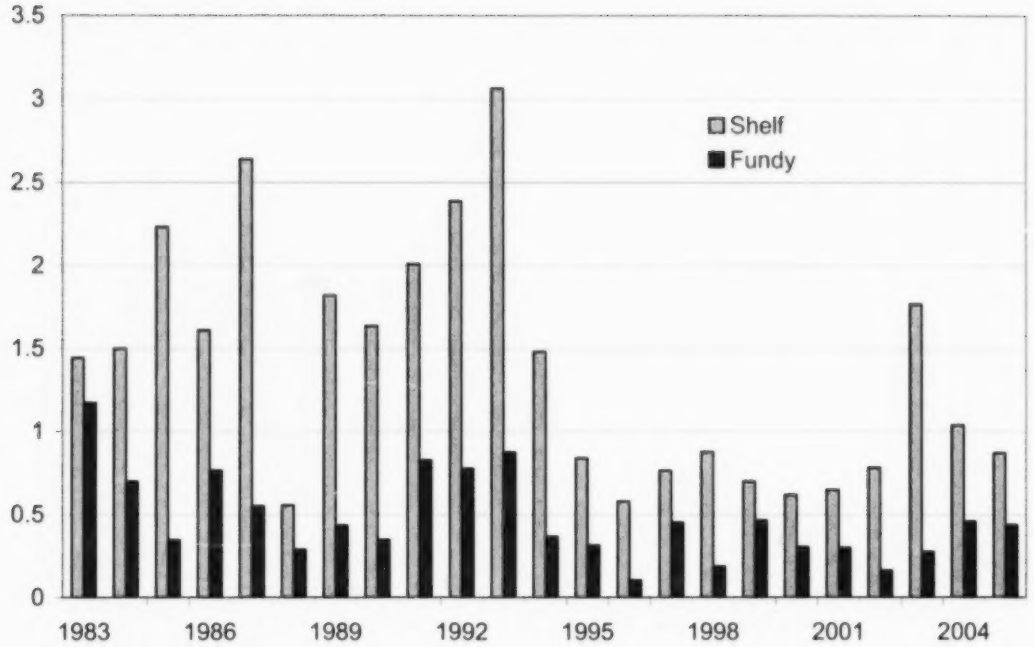

Figure 19. Relative fishing mortality by region for 4X cod.